10/516335

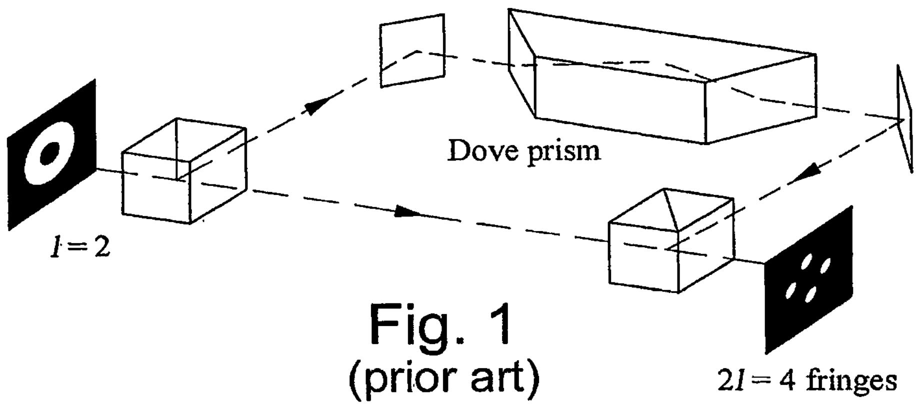

Fig. 1
(prior art)

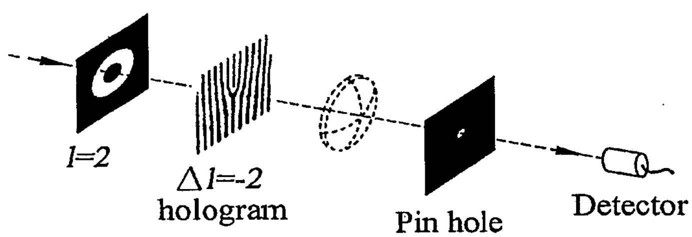

Fig. 2
(prior art)

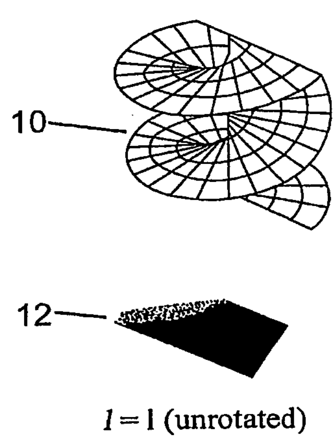

Fig. 3A

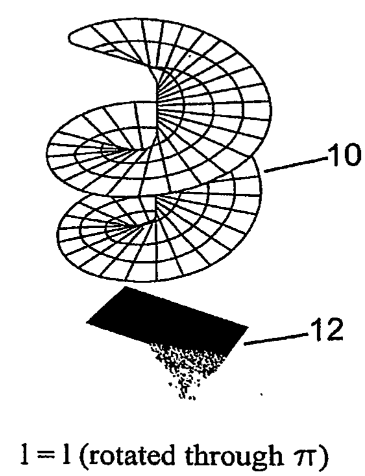

Fig. 3B

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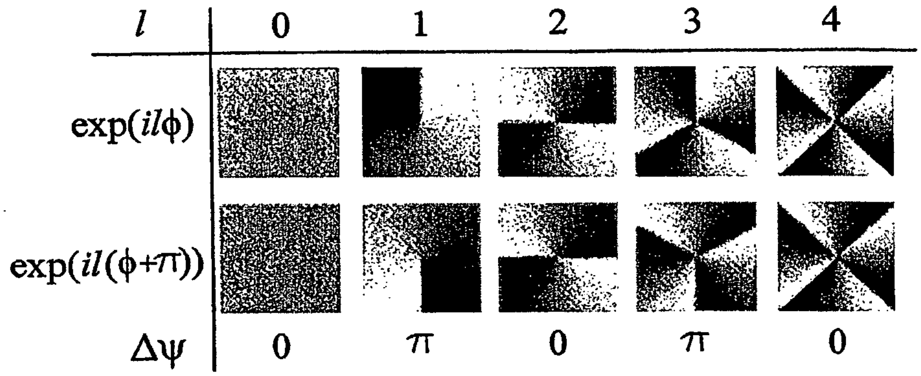

Fig. 4

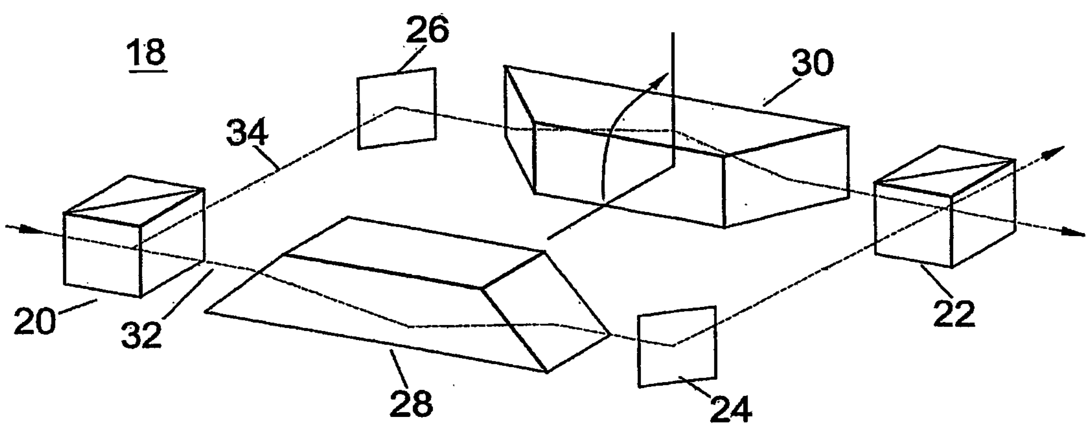

Fig. 5

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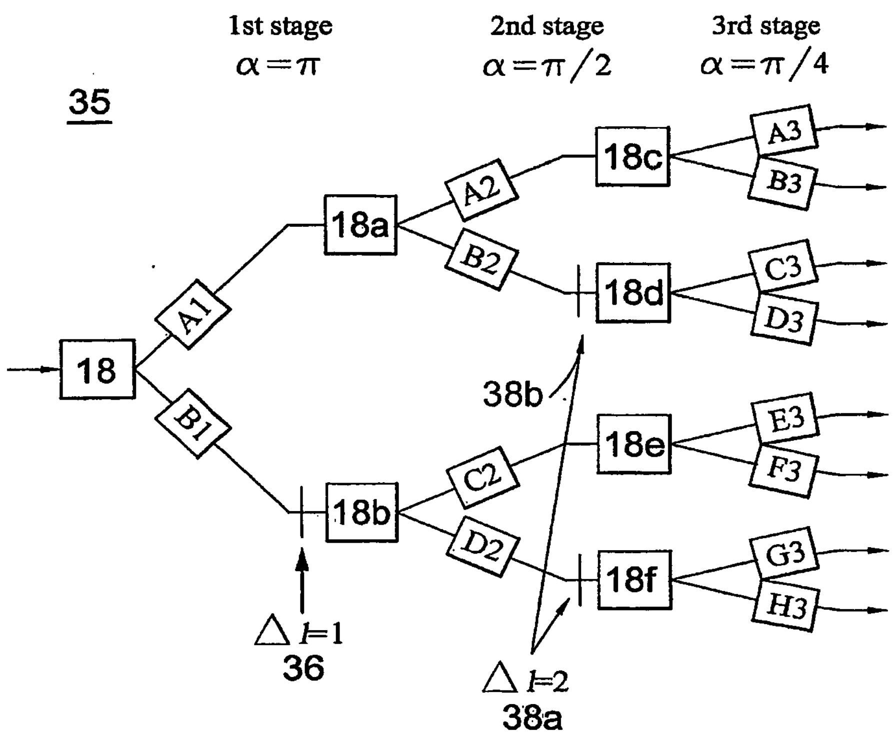
1st stage
$\alpha=\pi$
2nd stage
$\alpha=\pi/2$
3rd stage
$\alpha=\pi/4$
35
18
A1
B1
18a
18b
A2
B2
C2
D2
18c
18d
18e
18f
A3
B3
C3
D3
E3
F3
G3
H3
38b
$\triangle l=1$
36
$\triangle l=2$
38a

Fig. 6

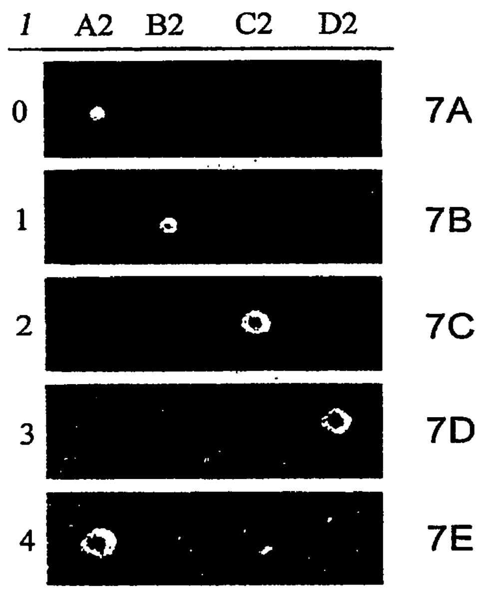

Fig.7

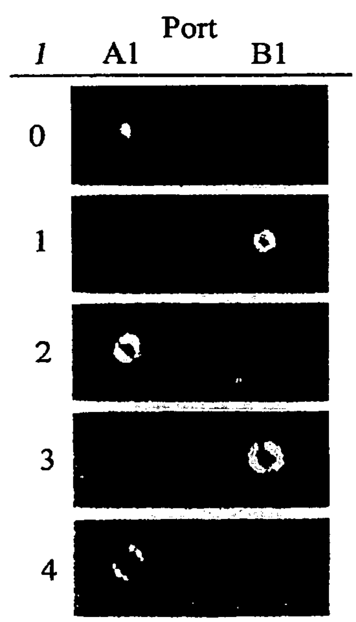

Fig. 8

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Fig. 9

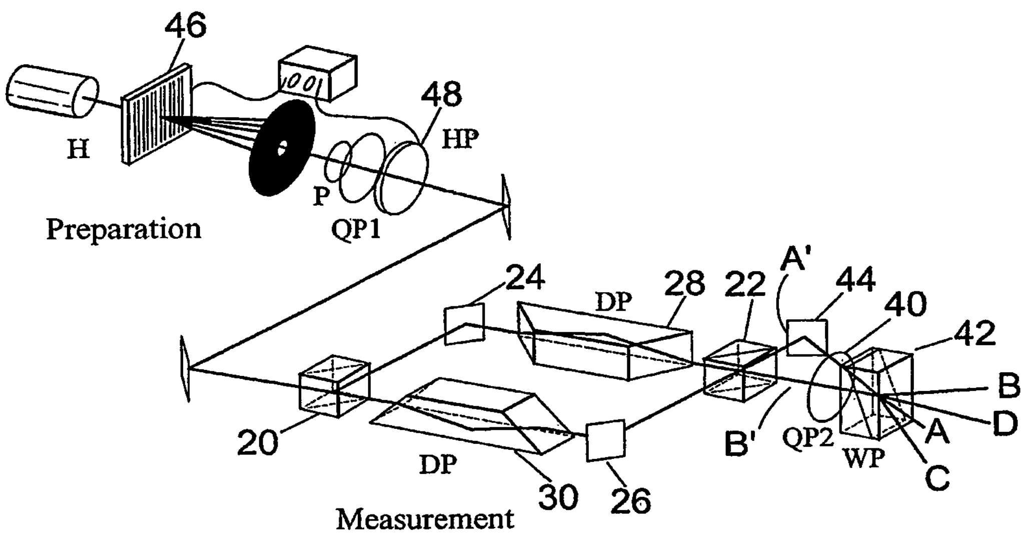

Fig. 10

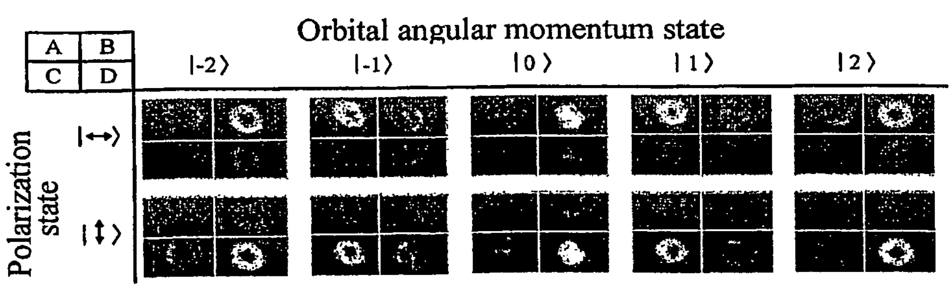

Fig. 11

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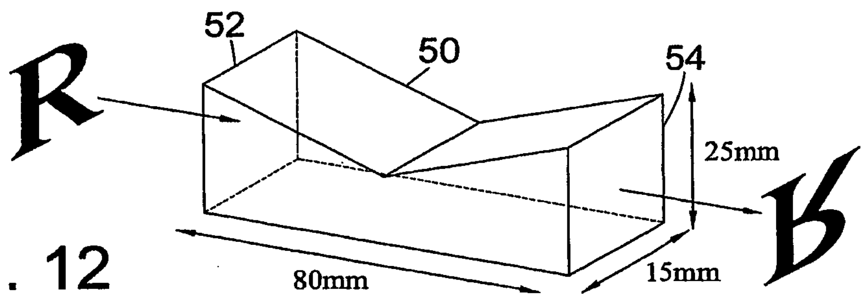


Fig. 12

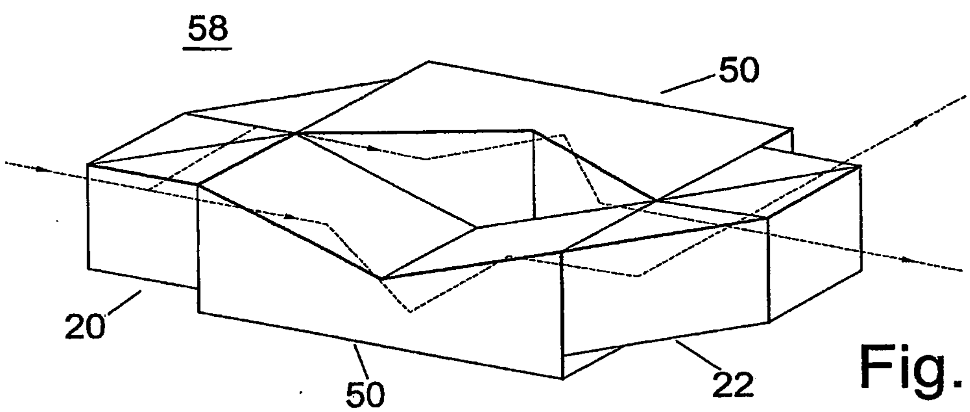


Fig. 13

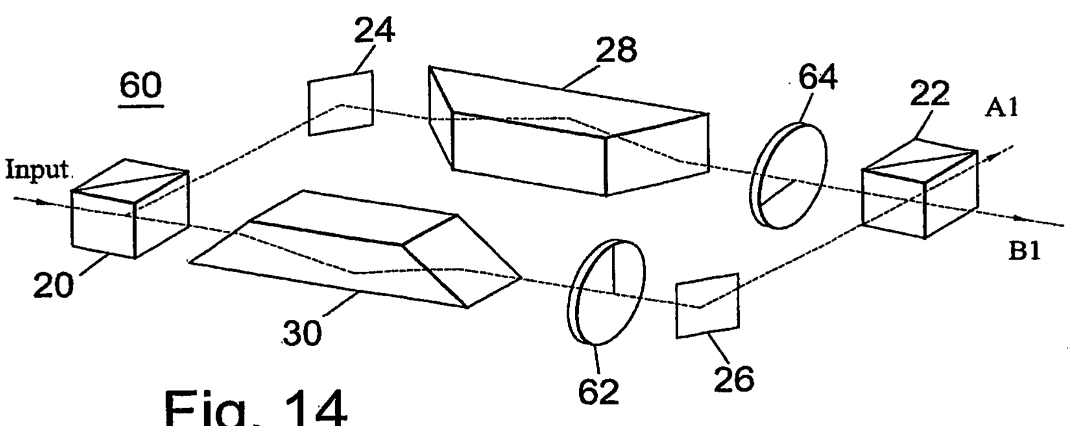


Fig. 14

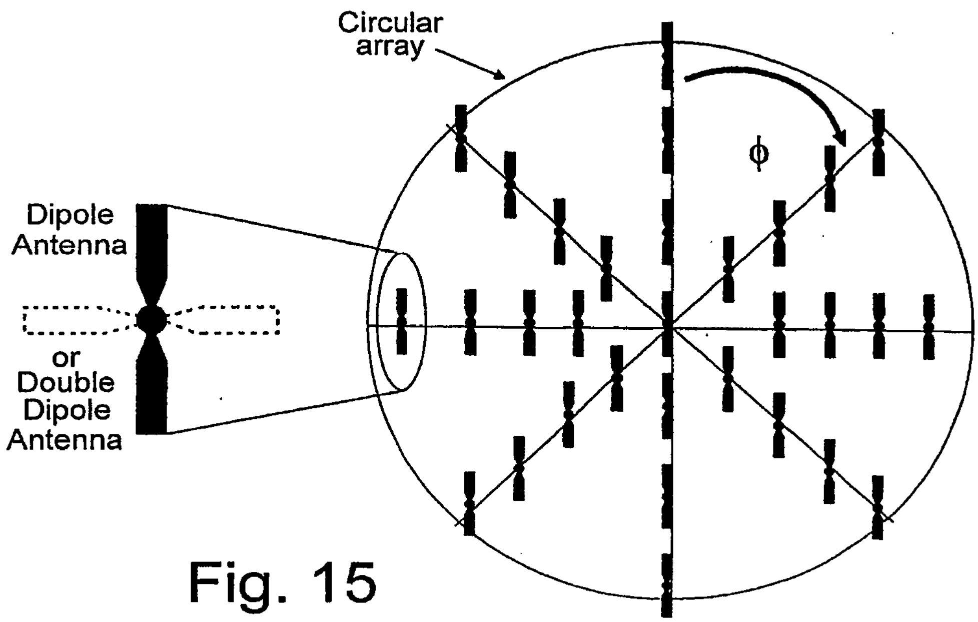

Circular array
Dipole Antenna
or
Double Dipole Antenna
ϕ

Fig. 15

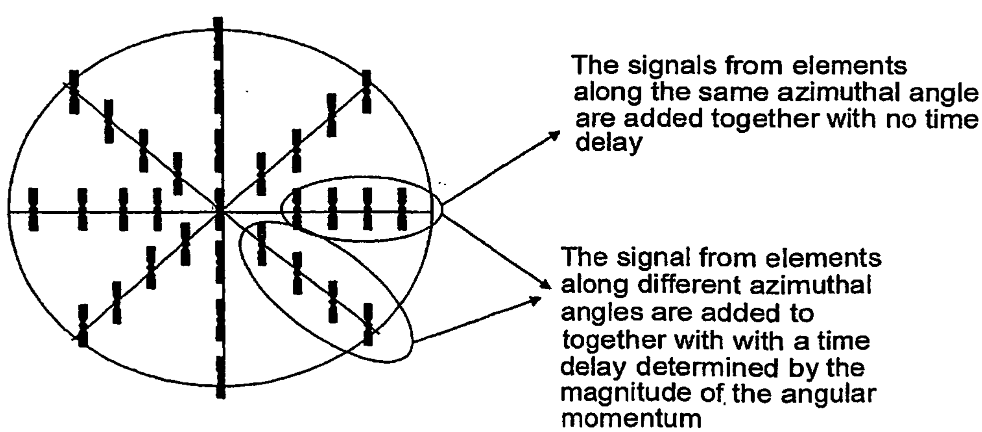
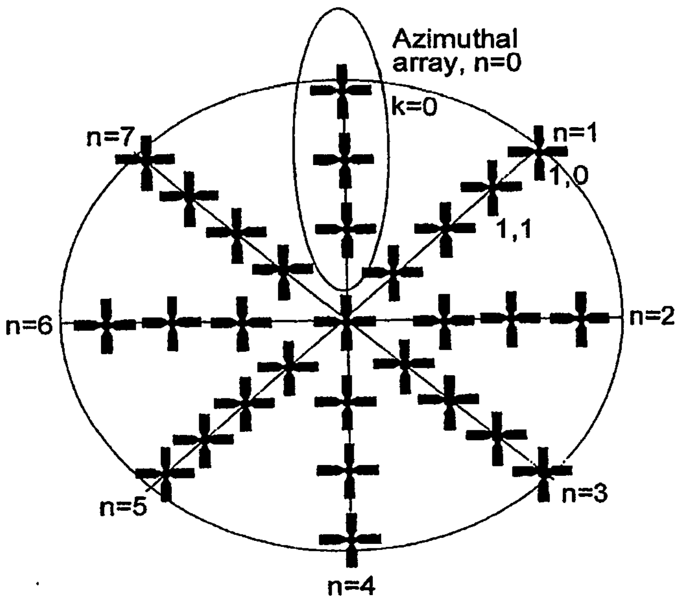

The signals from elements along the same azimuthal angle are added together with no time delay
The signal from elements along different azimuthal angles are added to together with with a time delay determined by the magnitude of the angular momentum

Fig. 16



For the case shown the total number of azimuthal arrays is 8 the angle between arrays $\pi/4$ radians in general there could be m, azimuthal arrays and an angle of $2\pi/m$ between them. Also in general we have a kth element along each azimuthal array and a total of s, elements in each azimuthal array.

The elements in each azimuthal array do not have a time delay between them

For each azimuthal array, to generation or detection of a beam of angular momentum,l,@ frequency, ω, requires a time delay (with respect to the n=0 array), given by:-

$$t = \frac{2\pi n l}{m\omega}$$

Followed by summation

Fig. 17

The total array is now described by a, m x r, matrix,A, as follows:-

$$A=\begin{bmatrix} s_{00} & \cdot & \cdot & \cdot & s_{0,r} \\ \cdot & & & & \\ \cdot & & & & \\ \cdot & & & & \\ s_{m,0} & \cdot & \cdot & \cdot & s_{m,r} \end{bmatrix}$$

where $s_{n,k}$ is the signal received at element ,k in the nth azimuthal array. To detect a received signal with angular momentum ,l, at frequency, ω the signal is processed as follows:-

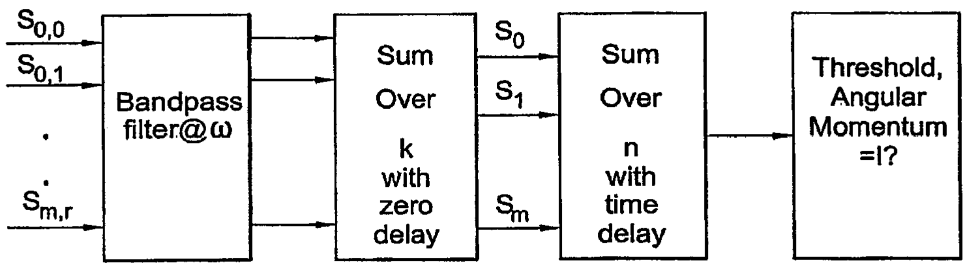


Fig. 18

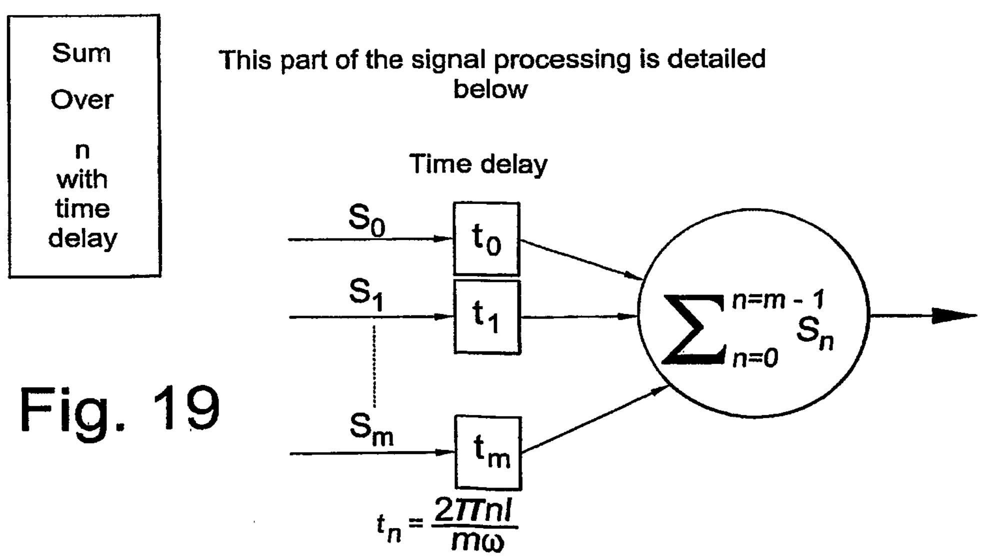


Fig. 19